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Hydrogel Formation Via Oligo- and Polypeptide Self-Assembly and Biocompatible Nanocomposite fabrication

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Introduction: Our research group is concerned with the development of novel biomaterials for tissue engineering and drug delivery applications. One part of our research involves designing amphiphilic oligo [1] and polypeptides [2] to form hydrogels via self-assembly with a unique micro and nanostructure at relatively low concentrations (~1wt%) and at different physiological conditions (pH and salt concentration). Understanding the intermolecular interactions enables us to identify the local structure and the reasons that drive these molecules to unique nanostructures. The second part of our research involves making nanocomposites out of biocompatible/biodegradable polymers such as PLLA and organophilic clay [3]. Objective this work is to study the effect of hydrophobicity of the surfactants used in the clay with different clay loadings.

Methods and Materials: All hydrogels were prepared by dissolving freeze-dried powder in deionized water. Nanocomposites were prepared with solution-intercalation film casting technique at different clay loads. Materials were investigated using both Wide and Small Angle X-Ray Scattering (WAXS, SAXS) techniques.

Results: WAXS data revealed that, 20 aminoacid long beta-hairpin molecules form beta-sheet structures with a spacing of 4.7 Å at basic or high salt concentration solution conditions and this property gives rise to gelation of these solutions. The other molecules in interest that form hydrogels are 200 aminoacid long diblock copolypeptides with hydrophobic and hydrophilic blocks. SAXS data showed that there is a regular ordering of the molecules in both hydrogels and cast films, which is due to the packing of the secondary structure of the hydrophobic blocks. Both chain length of the hydrophobic block and charge at the hydrophilic block was found to affect the local structure and consequent final materials properties. WAXS and SAXS data revealed that nanocomposite formation was obtained with both intercalation and exfoliation. It was found that the use of less hydrophobic surfactants tends to higher amount of exfoliation.

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References:

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